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## CAR-MOUNTED DISC PLAYER

### BACKGROUND

**[0001]** 1. Field of the Invention

**[0002]** The present invention relates to disc players for writing information in a disc such as a compact disc (CD) or a digital versatile disc (DVD) and/or for reading information written therein. In particular, the preferred embodiments of the present invention relate to a car-mounted disc player with a drive unit that is elastically supported on a chassis through an elastic member interposed therebetween. Further, the preferred embodiments of the present invention relate to the use of anti-vibration measures for switching the drive unit between a locked state and an unlocked state with respect to the chassis.

**[0003]** 2. Description of the Related Art

**[0004]** A car-mounted disc player for use with a disc such as a CD or a DVD may be susceptible to problems caused by external vibrations. For example, a disc player may contain a drive unit having an optical pickup, a turntable and so forth mounted that is fixedly supported on a chassis. In this instance, if an external vibration is exerted directly on the optical pickup and the disc during play (during writing or reading information), the problem of sound skipping or the like may result. In order to prevent such a problem, a car-mounted disc player is usually designed such that the drive unit is elastically supported on the chassis through the use of elastic members such as dampers so as to prevent an external vibration or shock from being exerted directly on the drive unit and the disc during play. More particularly, the car-mounted disc player of this type is equipped with a lock mechanism which switches the drive unit between a locked state and an unlock state with respect to the chassis. In this regard, during play for writing or reading information in a state in which the optical pickup is set so as to face the disc placed on the rotating turntable, the lock mechanism holds the drive unit in the unlocked state of being elastically supported on the chassis, and during disc-transfer for inserting or ejecting the disc, the lock mechanism holds the drive unit

in the locked state with respect to the chassis by constraining the drive unit. With this arrangement, anti-vibration measures such as dampers prevent a problem of sound skipping and the like even when an external vibration or shock is exerted during play. Further, by defining the positional relationship between the locked drive unit and a disc slot formed on the front surface of the chassis, an operation of inserting or ejecting the disc can be performed without any problems.

**[0005]** This car-mounted disc player has a structure in which a pair of sliders moving back and forth driven by a motor are disposed at both sides of the chassis and the lock mechanism and a clamp mechanism for bringing a clamper in or out of contact with the disc are activated in accordance with an advance or retreat position of the two sliders. These two sliders move in synchronization with each other by means of a link mechanism or the like. In a standby state in which the disc is not loaded, the clamper is held at an upper position where the clamper is brought out of contact with the turntable and the drive unit is brought in the locked state. Also, when the disc is transferred to a playing position of the disc player, the clamper moves down so as to press the disc on the turntable and the drive unit is brought into the unlocked state from the locked state.

**[0006]** The car-mounted disc player of this type may be used as a car-mounted navigation apparatus in addition to as an apparatus for playing back a music disc or the like, and the disc player is sometimes shipped in a package set together with a disc (CD-ROM, DVD, or the like) having map information written therein. In this case, although there are provided two systems for shipping the disc player; the one in an ejected state in which the disc is ejected from the disc player during transport and the other in a chucked state in which the disc is loaded in the disc layer during transport, the other system is usually employed in order to reduce the volume of the packed disc player. However, according to the foregoing related art, in the chucked state in which the disc placed at the playing position is clamped by the clamper and the turntable, since the drive unit is brought into the unlocked state from the locked state and is elastically supported on the chassis, when a strong external vibration or shock is exerted on the disc player during transport,

the disc hits against a stationary component such as the chassis and hence gets damaged.

[0007] Also, in the car-mounted disc player of this type, especially in the disc player for a DVD, the tilt of a laser beam emitted from the optical pickup must be adjusted at the final assembling stage of the disc player while the disc is rotating. However, since the drive unit remains in the unlocked state while the disc is played, a adjustment of the tilt of the optical pickup or the turntable is very difficult to the need to press the elastically supported drive unit by using, for example, an adjusting jig inserted in the chassis.

#### SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to provide a car-mounted disc player that prevents a disc from damage during transport even when the disc player is transported with a disc loaded therein and also that allows for less complicated adjusting a tilt of a pickup or a turntable.

[0009] A car-mounted disc player according to a preferred embodiment of the present invention includes a drive unit having at least a turntable and a pickup and elastically supported on a chassis having an elastic member interposed therebetween; a clamper-supporting member rotatably supporting a clamper; a clamp mechanism for activating the clamper-supporting member to relatively move toward or away from the drive unit so as to bring a disc in a clamped state or an unclamped state between the turntable and the clamper; a lock mechanism for bringing the drive unit in a locked state or an unlocked state with respect to the chassis; and a change-over mechanism for activating the clamp mechanism and the lock mechanism. During change-over operations for activating the clamp mechanism and the lock mechanism, the change-over mechanism can be halted at a half-locked position where the drive unit is brought in the locked state while the disc is being clamped by the turntable and the clamper.

[0010] Since the change-over mechanism for activating the clamp mechanism and the lock mechanism can be halted at the half-locked position where the drive unit is brought in the locked state while the disc is being clamped by the turntable

and the clasper, even when the car-mounted disc player is shipped in a state of having the disc loaded therein, the disc is prevented from damage during transport. Further, because the drive unit can be locked at the half-locked position while the disc is rotating, the adjustment of the tilt (skew) of the pickup or the turntable may be done without an additional jig for locking the drive unit.

**[0011]** In the disc player having the above-described structure, although the change-over mechanism suffices as long as it can activate the clamp mechanism and the lock mechanism to perform the respective change-over operations between clamping and unclamping the disc and between locking and unlocking the drive unit, it is preferable that the change-over mechanism have at least one slide member disposed on the chassis, and the clamp mechanism and the lock mechanism operate in accordance with a back-and-forth movement of the slide member. In this case, the slide member halting at the half locked position may be temporally fixed to the chassis by a connecting member such as an adhesive tape, a temporally fixing pin, or a screw, since the slide member can be reliably prevented from displacement during transport or during a skew adjusting work.

**[0012]** Also, it is preferable that the disc player having the above-described structure include position-detecting means for detecting the fact that the slide member reaches to the half-locked position, since the slide member can be easily halted at the half-locked position. Such position-detecting means can be formed by, for example, a detecting switch disposed on the chassis side and a drive portion disposed on the slide member side. In this case, when the drive portion is arranged so as to activate the detecting switch at the half-locked position, the slide member can be easily halted in accordance with an operating signal output from the detecting switch. Alternatively, the position-detecting means can be formed by first and second marks disposed on or in the slide member and the chassis, respectively. In this case, when the first and second marks are arranged so as to mate with each other at the half-locked position, the half-locked position is visually detected with ease so that the slide member is reliably halted at this position.

## BRIEF DESCRIPTION OF THE DRAWINGS

- [0013] Fig. 1 is a plan view of a car-mounted disc player according to an embodiment of the present invention;
- [0014] Fig. 2 is a perspective view of the disc player from which a top chassis is removed;
- [0015] Fig. 3 is a perspective view of the disc player from which the top chassis and a guide member are removed;
- [0016] Fig. 4 is an exploded perspective view of a drive unit, the guide member, first and second slide members, and so forth provided in the disc player;
- [0017] Fig. 5 is a perspective view of a link mechanism, the slide members, and so forth provided in the disc player;
- [0018] Fig. 6 is a plan view of the link mechanism in an ejected state;
- [0019] Fig. 7 is a plan view of the link mechanism during play;
- [0020] Figs. 8A and 8B respectively illustrate the first and second slide members provided in the disc player, both lying at an ejected position;
- [0021] Figs. 9A and 9B respectively illustrate the first and second slide members lying at a half-locked position;
- [0022] Figs. 10A and 10B respectively illustrate the first and second slide members lying at a playing position;
- [0023] Fig. 11 is a perspective view of the first slide member in an ejected state;
- [0024] Fig. 12 is a perspective view of the first slide member lying at the half-locked position;
- [0025] Fig. 13 is a perspective view of the first slide member during play;
- [0026] Fig. 14 is a plan view of a disc-positioning mechanism provided in the disc player;
- [0027] Fig. 15 is a front view of the disc-positioning mechanism;
- [0028] Fig. 16 is a right side view of the disc-positioning mechanism;
- [0029] Fig. 17 is a plan view of the disc-positioning mechanism illustrating a state in which a small disc is loaded;

[0030] Fig. 18 is a front view of the disc-positioning mechanism illustrating a state in which the small disc is loaded;

[0031] Fig. 19 is a plan view of the disc-positioning mechanism illustrating a state in which a large disc is loaded;

[0032] Fig. 20 is a front view of the disc-positioning mechanism illustrating a state in which the large disc is loaded;

[0033] Figs. 21A to 21D are plan views of the disc-positioning mechanism illustrating an operation of positioning the large disc;

[0034] Fig. 22 is a sectional view of the guide member provided in the disc player; and

[0035] Fig. 23 is a perspective view of a major part of a modification of position-detecting means for detecting a half-locked position.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0036] A car-mounted disc player according to the present embodiment can deal with two types of discs D having diameters of 8 cm and 12 cm. Hereinafter, the small and large discs having diameters of 8 cm and 12 cm are respectively denoted by SD and LD, if necessary.

[0037] As shown in Figs. 1 to 3, the car-mounted disc player has a chassis 1 and a top chassis 2 that form an external skeleton thereof and which are made by bending a metal plate. The chassis 1 has a front plate 1c at the front thereof and a slit-like slot 1d formed by cutting the upper portion of the front plate 1c, through which a disc D (small disc SD or large disc LD) is inserted into or ejected from the disc player. The central portion of the top chassis 2 is cut out on a large scale so that the top chassis forms a frame-like shape. Also, the top chassis 2 is fixed to the upper surface of the chassis 1 with screws and has a guide member 3 and a roller 4 disposed thereunder, forming a disc-transfer mechanism.

[0038] As shown in Fig. 4, the guide member 3 has a flat plate 3a and a pair of side plates 3b formed by bending the right and left sides of the flat plate 3a. Each of the side plates 3b has two drive pins implanted therein. The flat plate 3a has an under surface, each of right and left halves thereof having a gradually tapered

shape, slating downward from the central portion thereof toward the right and left side plates 3b. Also, the flat plate 3a has a pair of long narrow shaped recesses 3d at the right and left portions thereof, formed so as to protrude from the lower surface to the upper surface thereof, and has a pair of bends 3e at the front and rear edges thereof protruding upward. Since the drive pins 3c are engaged with corresponding cam grooves formed in a pair of slide members, which will be described later, when the two slide members move in a back-and-forth direction in synchronization with each other, the guide member 3 moves up and down while keeping a state of being parallel to the chassis 1.

[0039] As shown in Fig. 22, the guide member 3 is made by pressing a composite of a metal plate 3A and a resin layer 3B previously coated on the surface of the metal plate 3A. In this press working, the foregoing side plates 3b, recesses 3d, and bends 3e are formed. The metal plate 3A suffices as long as it has such a stiffness that its mechanical strength is sufficient for the guide member 3, and the resin layer 3B suffices as long as it has such a slippery property that the surface of the disc D is prevented from damage when the disc D is transported while being clamped by the guide member 3 and the roller 4. In a preferred embodiment, the metal plate 3A is made from a steel plate having subjected to a chromate treatment with a trivalent chrome and having a thickness of 1 mm, and the resin layer 3B is made from a fluorocarbon resin (ethylene- tetrafluoroethylene (ETFE) copolymer) film and having a thickness of 20  $\mu\text{m}$ . Thus, the composite is obtained by previously bonding the fluorocarbon resin film to the steel plate. Since the ETFE copolymer film is in general unlikely bonded to another member, one surface of the ETFE copolymer film is subjected to a primer treatment; a primer and the film are chemically bonded by heat; and the primer and the steel are thermally deposited to each other so that the fluorocarbon resin film serving as the resin layer 3B is bonded to the steel plate serving as the metal plate 3A.

[0040] Each of right and left halves of the roller 4 has a trapezoidal cone shape gradually becoming larger in diameter from the central portion toward the end thereof, and the roller 4 is driven to rotate in either a normal direction or a reverse direction by a power from a motor (not shown). The roller 4 is rotatably supported



at the rear portion of a roller bracket 5. The front portion of the roller bracket 5 is turnably supported by right and left latching plates 1b (see Fig. 3) formed by bending portions of the bottom surface of the chassis 1. Since both ends of the roller 4 are also engaged with corresponding cam grooves of the two slide members, which will be described later, when the two slide members move in the back-and-forth direction in synchronization with each other, the roller bracket 5 turns about its engaging portion with the latching plates 1b so as to activate the roller 4 to move up and down. With this structure, the disc D inserted through the slot 1d can be clamped by the lower surface of the guide member 3 and the roller 4. In this occasion, when the roller 4 is arranged such that the large-diameter portions thereof face the two recesses 3d of the guide member 3, the central portion of the disc D is reliably clamped by the guide member 3 and the roller 4.

**[0041]** As shown in Figs. 2 and 3, the chassis 1 has a pair of detecting levers 6 turnably supported on the bottom surface thereof and also has a circuit board 7 (see Figs. 11 to 13) fixed thereto and under the detecting levers 6. Each of the detecting levers 6 has a detecting pin 6a formed in a standing manner at the front thereof, and the upper end of the detecting pin 6a is inserted in an arch-shaped guide hole 2a perforated in the top chassis 2 (see Fig. 1). The detecting levers 6 are urged by a spring (not shown) in a direction in which the two detecting pins 6a come close to each other, and the detecting lever 6 lying at the left side in the drawing has a drive portion 6b disposed at the rear thereof. The circuit board 7 has a switch (not shown) mounted thereon. When the outer periphery of the disc D inserted through the slot 1d abuts against at least one of the detecting pins 6a and the corresponding detecting lever 6 accordingly turns outward by a predetermined angle, the foregoing switch is activated so as to start a drive motor for the foregoing roller 4 in accordance with the turning of this detecting lever 6.

**[0042]** The car-mounted disc display has a drive unit 8 disposed in the main body thereof, and the drive unit 8 has a drive chassis 9 formed by bending a metal plate. The drive chassis 9 is elastically supported on the bottom surface of the chassis 1 by elastic members such as a plurality of dampers 10 (see Figs. 6 and 7) or coil springs (not shown). The drive chassis 9 has lock pins 9a and 9b disposed

in a protruding manner at the left and right sides thereof, respectively, and also has a lock pin 9c and a lock pin (not shown) disposed in a protruding manner on the right side surface and the lower surface thereof, respectively. In addition, the drive chassis 9 has an optical pickup 11, a spindle motor 12, and so forth mounted thereon. The spindle motor 12 has a turntable 13 fixed to the rotating axis thereof (see Fig. 15). Furthermore, the drive chassis 9 has an arm clamp (clammer-supporting member) 14 disposed thereon. The arm clamp 14 is supported so as to be vertically translated since a pair of guide grooves 14a formed on the right and left side surfaces thereof are respectively engaged with the lock pins 9a and 9c of the drive chassis 9. The arm clamp 14 has a projecting piece (not shown) integrally formed by bending a portion of the left side surface thereof and also has a pair of front and rear drive pins 14b disposed on the right side thereof in a protruding manner. In addition, the arm clamp 14 has a clamper 15 rotatably supported thereon, and the pair of drive pins 14b of the arm clamp 14 are inserted in a pair of corresponding cam holes 16b of a drive arm 16 (see Fig. 16). The drive arm 16 is supported at the right end of the drive chassis 9 so as to be slidable in the back-and-forth direction and is elastically urged by a spring 17 toward the slot 1d. Also, the drive arm 16 has an engaging projection 16a which engageably faces a projection of the right slide member, which will be described later.

**[0043]** As shown in Figs. 14 to 16, the drive chassis 9 has a pair of positioning members 18 and 19 turnably supported thereon. The positioning members 18 and 19 respectively position the center holes of the discs SD and LD, having different diameters from each other, with respect to the turntable 13. The left positioning member 18 is formed by an arm lever (an abutment) 18b, made from a synthetic resin and having a toothed portion 18a at the rear thereof, and by a regulating arm (a regulatory portion) 18c made from a leaf spring. The regulating arm 18c is cantilevered such that its base portion is fixed to the front of the arm lever 18b and its free end elastically abuts against the lower surface of the arm clamp 14. The right positioning member 19 is formed by an arm lever (an abutment) 19b, made from a metal plate and having a toothed portion 19a at the rear thereof, and by a regulating arm (a regulatory portion) 19c made from a leaf spring. The regulating

arm 19c is cantilevered such that its base portion is fixed to the front of the arm lever 19b and its free end also elastically abuts against the lower surface of the arm clamp 14. The two positioning members 18 and 19 turn in synchronization with each other by arranging the corresponding toothed portions 18a and 19a to engage with each other and are urged by a spring (not shown) in a direction in which the fronts thereof come closer to each other.

[0044] Also, the drive chassis 9 has a first-end detecting lever 36 turnably supported thereon and a lock lever 20 supported thereon so as to be horizontally movable. The first-end detecting lever 36 has a detecting portion 36a contactable with the outer periphery of the disc SD having a diameter of 8 cm. The detecting portion 36a lies at the center between the two arm levers 18b and 19b. The arm lever 18b of the positioning member 18 and the first-end detecting lever 36 are connected to each other via a pin and a long hole (both not shown) such that the first-end detecting lever 36 turns toward the remotest side of the drive chassis 9 in conjunction with the outward turning of the left positioning member 18. In addition, the first-end detecting lever 36 has a relay member (not shown) connected to the end thereof lying on the other side of the detecting portion 36a so that the turning of the first-end detecting lever 36 is selectively transmitted to a second-end detecting lever, which will be described later, via the relay member. The lock lever 20 has a lock portion 20a formed at the rear thereof, which is engageable with the arm lever 18b of the left positioning member 18, and is urged by a spring (not shown) to the left of the drive chassis 9. The lock lever 20 has a pressing portion 20b disposed at the front thereof so as to face the drive portion 6b of the foregoing left detecting lever 6. When the disc LD having a diameter of 12 cm is inserted into the disc player, the drive portion 6b presses the pressing portion 20b so that the lock lever 20 is moved rightward in order to remove the restriction of the positioning member 18 caused by the foregoing lock portion 20a.

[0045] The foregoing two slide members are disposed on the inner surfaces of right and left side surfaces 1a of the chassis 1. Hereinafter, the left and right slide members are respectively referred to as a first slide member 21 and a second slide member 22. The two slide members 21 and 22 are composed of a synthetic resin

and are supported on the chassis 1 so as to be movable in the back-and-forth direction.

**[0046]** As shown in Figs. 6 and 7, the chassis 1 has a second-end detecting lever 37 and a motor 23 serving as a drive source for the first slide member 21 turnably supported and disposed, respectively, at the left remote end of the bottom surface thereof. The second-end detecting lever 37 has a detecting portion 37a contactable to the outer periphery of the disc LD having a diameter of 12 cm and is urged clockwise by a spring (not shown). The power of the motor 23 is transmitted to a gear 38 lying at the final stage of a gear train via the gear train. The left first slide member 21 has a rack 24 facing the gear 38 and supported on the bottom plate thereof so as to be movable in the back-and-forth direction by a predetermined distance. Although the rack 24 is urged backward by a spring (not shown) so as to move away from the gear 38, when the second-end detecting lever 37 turns counterclockwise and is pressed forward by the end of the second-end detecting lever 37 on the other side of the detecting portion 37a, the rack 38 engages with the gear 38. Thus, when the rack 24 is moved forward by a predetermined distance by the power of the motor 23, the moving force of the rack 24 is transmitted to the first slide member 21, and thus a rack portion 21h formed on the bottom plate of the first slide member 21 engages with the gear 38. With this structure, the power of the motor 23 is transmitted to the left first slide member 21 via the gear 38, and the movement of the first slide member 21 is transmitted to the right second slide member 22 via a link mechanism 25.

**[0047]** As shown in Fig. 5, the link mechanism 25 is formed by first and second link levers 26 and 27, which are turnably supported on the bottom surface of the chassis 1. The left end of the first link lever 26 is turnably connected to the rear end of the first slide member 21; the right end of the second link lever 27 is turnably connected to the rear end of the second slide member 22; and a pin 26a implanted in the right end of the first link lever 26 is inserted in a cam hole 27a perforated in the left end of the second link lever 27. Accordingly, when the first link lever 26 turns in accordance with the back and forth movement of the first slide member 21, the pin 26a moves within the cam hole 27a so as to cause the

second link lever 27 to turn, thereby allowing the second slide member 22 to move back and forth in the same direction as the first slide member 21. That is, the first slide member 21 is a driver powered by the motor 23, and the second slide member 22 is an idler movable in synchronization with the first slide member 21.

[0048] The chassis 1 has a lock lever 28 turnably supported on the inner surface of the left side plate 1a. Since the lock lever 28 turns as the first slide member 21 moves back and forth, in accordance with this movement, the lock pin 9a disposed at the left of the drive chassis 9 is engaged or disengaged.

Meanwhile, the chassis 1 has a lock slide member 29 and a link arm 30 supported on the inner surface of the right side plate 1a thereof so as to be movable in the back-and-forth direction and to be turnable, respectively. Since the link arm 30 turns as the second slide member 22 moves back and forth, in accordance with this movement, the lock slide member 29 moves back and forth in the opposite direction to the second slide member 22. The lock slide member 29 has a lock hole 29a perforated therein, which engages with or disengages from the lock pin 9b disposed at the right of the drive chassis 9. Also, the chassis 1 has a center lock lever 31 having a lock arm 31a turnably supported on the bottom surface thereof. Since the center lock lever 31 turns in conjunction with the first link lever 26, a lock pin (not shown) disposed at the central portion of the lower surface of the drive chassis 9 is engaged or disengaged in accordance with this movement.

[0049] As shown in Figs. 8 to 13, the left first slide member 21 has a plurality of cam grooves 21a to 21e formed on the inner surface thereof and also has first and second drive portions 21f and 21g integrally formed on the inner bottom thereof. The first slide member 21 has a cam-shaped pressing piece 21j formed on the inner surface thereof. Since the pressing piece 21j lies at a position in which it can get under the foregoing projecting piece integrally formed with the arm clamp 14, when the pressing piece 21j gets under the projection piece, the arm clamp 14 is moved up. Meanwhile, the foregoing circuit board 7 has first and second detecting switches 32 and 33 mounted thereon. The first detecting switch 32 has an actuator portion 32a protruding out from the left side surface of the circuit board 7 and the second detecting switch 33 has an actuator portion 33a protruding

upward from the circuit board 7. The first detecting switch 32 is activated when the first drive portion 21f presses the actuator portion 32a during the forward movement of the first slide member 21. Thus, the first drive portion 21f and the first detecting switch 32 serve as position-detecting means which can detect a half-locked position, which will be described later. The second detecting switch 33 is activated when the second drive portion 21g presses the actuator portion 32a during the forward movement of the first slide member 21, and thus the second drive portion 21g and the second detecting switch 33 serve as a road-end detecting means. The right second slide member 22 also has a plurality of cam grooves 22a to 22c formed on the inner surface thereof and has a protrusion 22d formed on the upper surface thereof. Figs. 8A to 10A illustrate the first slide member 21 and Figs. 8B to 10B illustrate the second slide member 22, both viewed from the inside of the main body of the disc player.

**[0050]** Both ends of the roller 4 engage with the cam grooves 21a and 22a of the two slide members 21 and 22, and left two and right two of the four drive pins 3c of the guide member 3 engage with the cam grooves 21b and 21c of the slide member 21 and the cam grooves 22b and 22c of the slide member 22, respectively. The left lock pin 9a of the drive chassis 9 engages with the cam groove 21d of the first slide member 21, and a pin 28a implanted in the lock lever 28 engages with the cam groove 21e of the first slide member 21. In addition, the engaging projection 16a of the drive arm 16 engageably faces the protrusion 22d of the second slide member 22, and the pair of drive pins 14b of the arm clamp 14 are inserted in the pair of cam holes 16b. Also, the right lock pin 9b of the drive chassis 9 engages with the lock hole 29a of the lock slide member 29 which moves in the opposite direction to the second slide member 22 via the link arm 30. With this structure, when the first and second slide members 21 and 22 move back and forth in the same direction, in accordance with this movement, the roller 4 and the guide member 3 move up and down; the drive chassis 9 is locked and unlocked; and the arm clamp 14 moves up and down.

**[0051]** As described above, in the present embodiment, the pair of drive pins 14b and the projecting piece of the arm clamp 14, the pressing piece 21j of the

first slide member 21, and the drive arm 16 form a clamp mechanism for clamping and unclamping the disc D between the clamper 15 and the turntable 13 by activating the arm clamp 14 to move in an up-and-down direction along which the arm clamp 14 moves toward and away from the drive chassis 9. Also, the lock pins 9a and 9b of the chassis 9 and the lock pin on the lower surface of the same, the cam groove 21d of the first slide member 21, the lock lever 28, the lock slide member 29, the link arm 30, and the center lock lever 31 form a lock mechanism which locks or unlocks the drive unit 8 to or from the chassis 1. In addition, the first and second slide members 21 and 22 and the link mechanism 25 form a change-over mechanism for activating the foregoing clamp mechanism and lock mechanism to perform the respective change-over operations.

**[0052]** As shown in Fig. 3, the chassis 1 has a positioning hole 34 perforated in the left side plate 1a thereof, and the first slide member 21 has a positioning hole or depression (not shown) formed therein which is similar to the positioning hole 34. By inserting a temporal fixing pin 35 in and latching it with the positioning hole 34 or the positioning depression from the outside of the left side plate 1a of the chassis 1, the first slide member 21 is prevented from moving at a half-locked position, which will be described later, with respect to the chassis 1.

Alternatively, when the positioning depression of the first slide member 21 and the temporal fixing pin 35 are formed as a screw hole and a male screw, respectively, the first slide member 21 may be firmly fixed by screwing the temporary pin into the positioning depression.

**[0053]** During ejection (in a standby state) where the disc player has no disc D (small disc SD or large LD) inserted in the main body thereof, the first and second slide members 21 and 22 remain at a retreat position on the remotest side of the chassis 1. As shown in Figs. 8A and 8B, during the above-mentioned ejection, both ends of the roller 4 lie at corresponding upper positions and on the near side of the cam grooves 21a and 22a, and the drive pins 3c of the guide member 3 lie at corresponding middle positions and on the near side of the cam grooves 21b, 22b, 21c, and 22c. With this arrangement, the guide member 3 is held at a descent position corresponding to the slot 1d, and the roller 4 is held at an ascent position

in which the roller 4 is pressed against the lower surface of the guide member 3. The left lock pin 9a of the drive chassis 9 is restrained by the cam groove 21d of the first slide member 21 and the lock lever 28 from the rear and front directions; the right lock pin 9b of the same is latched with the inner periphery of the lock hole 29a of the lock slide member 29; and also, the lock pin (not shown) on the lower surface of the drive chassis 9 is latched with the lock arm 31a of the center lock lever 31. As a result, the drive unit 8 remains in a locked state of being fixedly supported on the chassis 1 in the back-and-forth direction as well as in the horizontal and vertical directions. In addition, since the engaging projection 16a of the drive arm 16 is pressed against the protrusion 22d of the second slide member 22 and thus the drive arm 16 also remains at its retreat position, as shown in Fig. 16, the two drive pins 14b of the arm clamp 14 move up along the corresponding two cam holes 16b of the drive arm 16. Also, since the pressing piece 21j of the first slide member 21 gets under the projecting piece of the arm clamp 14 and lifts this projecting piece upwards, the arm clamp 14 is held in an ascend position in which it detaches from the drive chassis 9. With this arrangement, as shown in Fig. 15, the clamper 15 lies right above the turntable 13 so as to provide a space in which the disc D is inserted. In this stage, the regulating arms 18c and 19c of the two positioning members 18 and 19 respectively extend from the arm levers 18b and 19b toward the clamper 15 and elastically abut against the lower surface of the arm clamp 14, and the lock portion 20a of the lock lever 20 is latched with the arm lever 18b so as to restrain the turning of the positioning member 18.

**[0054]** In such a standby state, when the disc D (small disc SD or large disc LD) starts to be inserted into the main body of the disc player from the approximate center of the slot 1d, the outer periphery of the front side of the disc D in the inserting direction thereof comes into contact with the detecting pins 6a of the two detecting levers 6, and the insertion force of the disc D causes the two detecting levers 6 to turn outward. When a switch (not shown) detects the fact that at least one of the detecting levers 6 turns by a predetermined angle, a motor (not shown) starts to rotate the roller 4. When the disc D is further inserted, the front



portion of the disc D in the insertion direction is clamped by the lower surface of the guide member 3 and the roller 4, and the rotation force of the roller 4 causes the disc D to be transferred in the main body of the disc player. Because the drive chassis 9 is maintained in a locked state and the arm clamp 14 is held at a standby position above the drive chassis 9, the drive chassis 9 and the arm clamp 14 (i.e., the turntable 13 and the clamper 15) have a transfer route for the disc D inserted therebetween. When the disc D is detected by the above-mentioned switch detects the fact that the disc D is inserted, the motor 23 disposed at the left remote end on the chassis 1 starts to rotate.

[0055] When the inserted disc D is a small disc SD having a diameter of 8 cm, since the outward turning of the two detecting levers 6 forms a small angle, the pressing portion 20b of the lock lever 20 does not come into contact with the drive portion 6b of the left detecting lever 6 during the transfer of the disc SD, and the two positioning members 18 and 19 remain in a lock state of being restrained at a predetermined open angle (at a first position). When the disc SD is inserted from the left side of the slot 1d, although the drive portion 6b of the left detecting lever 6 causes the lock lever 20 to slide rightward once, since the detecting levers 6 return to their original states while the disc SD is moving toward the remote side, upon transfer of the disc SD to a position in which the center hole of the disc SD lies right above the turntable 13, the two positioning members 18 and 19 return to the lock state. With this arrangement, when the disc SD passes through the space between the drive chassis 9 and the arm clamp 14 and is transferred to the remote side of the chassis 1, as shown in Figs. 17 and 18, two points of the outer periphery of the front side of the disc SD in the transfer direction come into contact with the fronts of the two arm levers 18b and 19b, and thus the center hole of the disc SD is properly positioned with respect to the turntable 13. In this case, since the regulating arms 18c and 19c of the two positioning members 18 and 19 respectively extend from the fronts of the arm levers 18b and 19b and elastically abut against the lower surface of the arm clamp 14, even when an external vibration or shock is exerted on the disc player, the disc SD during transfer does not pass over above the two arm levers 18b and 19b and is accordingly reliably

positioned by the two positioning members 18 and 19 while being guided by the regulating arms 18c and 19c.

[0056] When the disc SD is positioned with respect to the turntable 13 as mentioned above, since the front of the disc SD comes into contact with the detecting portion 36a and the first-end detecting lever 36 turns counterclockwise, the second-end detecting lever 37 also turns counterclockwise via the relay member (not shown) so as to engage the rack 24 with the gear 38. Subsequently, when the rack 24 moves on the bottom plate of the first slide member 21 up to a position where the rack 24 is limited to move, the rack 24 and the first slide member 21 are actually integrated, whereby the first slide member 21 starts to move forward and the rack portion 21h engages with the gear 38. As a result, the rotating power of the motor 23 is transmitted to the left first slide member 21 via the gear 38; the movement of the first slide member 21 is transmitted to the right second slide member 22 via the link mechanism 25; and the first and second slide members 21 and 22 start to move from the retreat position on the remotest side of the chassis 1 to an advance position thereof. In addition, upon the disc SD being positioned with respect to the turntable 13, because the two detecting levers 6 detach from the disc SD and return to their original positions, the foregoing switch detects this movement and stops the roller 4 to rotate. Alternatively, the rotation of the roller 4 may be stopped by detecting the turning of the second-end detecting lever 37 with a switch (not shown).

[0057] Meanwhile, when the inserted disc D is a large disc LD having a diameter of 12 cm, since the outward turning of the two detecting levers 6 forms a wider angle than in the case of the disc SD, during the transfer of the disc LD, the pressing portion 20b of the lock lever 20 is pressed by the drive portion 6b of the left detecting lever 6 and thus the lock lever 20 moves rightward. As a result, the two positioning members 18 and 19 are released from the restriction of the lock portion 20a of the lock lever 20. With this arrangement, when the disc LD passes through the space between the drive chassis 9 and the arm clamp 14 and is transferred to the remote side of the chassis 1, as shown in Figs. 21A and 21D, two points of the outer periphery of the front side of the disc LD in the transfer

direction come into contact with the fronts of the two arm levers 18b and 19b, and then the transfer force of the disc LS causes the two positioning members 18 and 19 to turn outwards so as to widen an angle formed between these members. In accordance with this movement, the two regulating arms 18c and 19c slide on the lower surface of the arm clamp 14. When the two positioning members 18 and 19 is stopped at a predetermined open angle (at a second position) by a stopper (not shown), as shown in Figs. 19, 20, and 21D, the outer periphery of the disc LD abuts against the inner circumferential surface of the two arm levers 18b and 19b. As a result, the center hole of the disc LD is properly positioned with respect to the turntable 13. Also, in this case, since the regulating arms 18c and 19c of the two positioning members 18 and 19 respectively extend from the fronts of the arm levers 18b and 19b and elastically abut against the lower surface of the arm clamp 14, even when an external vibration or shock is exerted on the disc player, the front side of the disc LD in the transfer direction is guided by the regulating arms 18c and 19c, whereby the disc LD during transfer does not pass over above the two arm levers 18b and 19b and is accordingly reliably positioned by the two positioning members 18 and 19.

[0058] As stated previously, since the first-end detecting lever 36 and the arm lever 18b of the positioning member 18 are connected to each other via the pin and the long hole (both not shown), although the first-end detecting lever 36 turns such that the detecting portion 36a thereof detaches from the disc LD in conjunction with the positioning member 18, the rotation force of the first-end detecting lever 36 is cut off by the relay member so as not to be transmitted to the second-end detecting lever 37. When the disc LD is positioned with respect to the turntable 13, the outer periphery of the disc LD during transfer comes into contact with the detecting portion 37a so as to turn the second-end detecting lever 37, whereby the rack 24 is pressed by the second-end detecting lever 37 and thus engages with the gear 38. Then, in the similar fashion to the foregoing small disc SD, the rotating power of the motor 23 is transmitted to the left first slide member 21 via the gear 38, and the first and second slide members 21 and 22 start to move from the retreat position on the remotest side of the chassis 1 to the advance position. When the

disc LD is positioned with respect to the turntable 13, the rotation of the roller 4 is stopped.

[0059] When the disc D (small disc SD or large LD) is positioned with respect to the turntable 13 as described above and the rotating power of the motor 23 is transmitted to the left first slide member 21, the movement of the first slide member 21 is transmitted to the second slide member 22 via the link mechanism 25 formed by the first link lever 26 and the second link lever 27. This results in the movement of the left and right slide members 21 and 22 from the retreat position to the advance position in the direction indicated by the arrow E in Fig. 6 in synchronization with each other without generating a substantial phase lag.

[0060] While the first and second slide members 21 and 22 are moving from the retreat position shown in Figs. 8A and 8B to a position shown in Figs. 9A and 9B, both ends of the roller 4 move from the corresponding upper positions to lower positions of the cam grooves 21a and 22a, and the drive pins 3c of the guide member 3 move from the corresponding middle positions to lower positions of the cam grooves 21b, 22b, 21c, and 22c and then to corresponding middle positions of sloped portions of the same. As a result, the guide member 3 moves down from the foregoing descent position to its lowest position and then moves up so as to return to the lower position, and the roller 4 moves to its descent position and thus detaches from the lower surface of the disc D. Although the lock pin 9a moves within the cam groove 21d, since the pin 28a of the lock lever 28 moves in a horizontal portion of the cam groove 21e, the lock pin 9a remains in being latched with the lock lever 28. Likewise, since the second slide member 22 moves in a range so as not to affect the attitude of the link arm 30, the lock slide member 29 remains at rest; accordingly, the lock pin 9b is also latched with the lock hole 29a of the lock slide member 29, and the lock pin (not shown) on the lower surface of the drive chassis 9 remains in being latched with the lock arm 31a of the center lock lever 31, whereby the drive unit 8 remains in a locked state of being fixedly supported on the chassis 1. Meantime, when the protrusion 22d of the second slide member 22 moves forward, the drive arm 16 moves forward by a predetermined distance urged by the spring 17, while the engaging projection 16a

of the drive arm 16 remains in contact with the protrusion 22d. Thus, the pair of drive pins 14b of the arm clamp 14 moves down along the corresponding cam holes 16b of the drive arm 16. At the same time, when the first slide member 21 moves forward, the pressing piece 21j detaches from the projecting piece of the arm clamp 14, thereby causing the arm clamp 14 to move down so as to come closer to the drive chassis 9. As a result, the clamper 15 supported by the arm clamp 14 comes close to the turntable 13, and the periphery of the center hole of the disc D is chucked between the turntable 13 and the clamper 15. While the disc D is being placed on the turntable 13 from its transfer height, the guide member 3 also moves down together with the clamper 15 due to the cam shapes of the cam grooves 21b and 21c and the cam grooves 22b and 22c of the slide members 21 and 22, respectively, while the guide member 3 remains in contact with the upper surface of the disc D, whereby the disc D positioned by the two positioning members 18 and 19 is reliably chucked between the turntable 13 and the clamper 15. Also, since the regulating arms 18c and 19c of the corresponding positioning members 18 and 19 are deformed due to their own elasticity while elastically abutting against the lower surface of the descending arm clamp 14, the arm clamp 14 is not prevented by the regulating arms 18c and 19c from moving up and down.

[0061] When the first and second slide members 21 and 22 move to the position shown in Figs. 9A and 9B, the drive unit 8 remains in the locked state of being fixedly locked to the chassis 1 while the disc D is being chucked (clamped) between the turntable 13 and the clamper 15. In the following description, this position will be referred to as a half-locked position.

[0062] While the first and second slide members 21 and 22 are moving from the half-locked position shown in Figs. 9A and 9B to the advance position on the nearest side of the chassis 1 shown in Figs. 10A and 10B, the two ends of the roller 4 moves to the lower positions on the remote sides of the cam grooves 21a and 22a, and the drive pins 3c of the guide member 3 move from the corresponding middle positions of the sloped portions of the cam grooves 21b, 22b, 21c, and 22c to the corresponding upper positions of the same. As a result, the guide member 3 moves from the descent position to the ascend position and

detaches further from the upper surface of the disc D, and also the roller 4 is held at the descend position away from the lower surface of the disc D, thereby providing a large space, in which the disc D is not prevented from rotation, between the guide member 3 and the roller 4. Also, the lock pin 9a moves to a position at which it disengages from the cam groove 21d, and the pin 28a moves from the horizontal portion of the cam groove 21e to a sloped portion of the same so as to turn the lock lever 28, whereby the latching of the lock pin 9a with the lock lever 28 is released. In addition, since the link arm 30 turns such that as the second slide member 22 moves from the position shown in Fig. 9B to the position shown in Fig. 10B, the lock slide member 29 moves to the remote side of the chassis 1, the latching of the lock pin 9b with the lock slide member 29 is released, and since the center lock lever 31 turns to a large extent in conjunction with the first link lever 26 (see Fig. 7), the latching of the lock pin on the lower surface of the chassis 9 with the center lock lever 31 is also released at the same time. As a result, the drive chassis 9 is elastically supported on the chassis 1 by the dampers 10 or the like and the drive unit 8 is changed over from the locked state to the unlock state.

[0063] The disc player is brought into a playing state as described above. In this playing state, when the spindle motor 12 is driven to rotate, the turntable 13, the disc D, and the clamper 15 rotate integrally so that information is written in and/or read from the disc D by the optical pickup 11. During ejection where the slide members 21 and 22 remain at the retreat position on the remotest side of the chassis 1, as shown in Fig. 11, the second drive portion 21g of the first slide member 21 lies away from the actuator portion 33a of the second detecting switch 33. Meanwhile, when the slide members 21 and 22 move to the advance position on the nearest side of the chassis 1 so as to bring the disc player into the playing state, as shown in Fig. 13, the second drive portion 21g comes into contact with the actuator portion 33a so as to turn on the second detecting switch 33. Accordingly, when the rotation of the motor 23 is stopped by using an output signal from the second detecting switch 33 as a road end signal, the slide members 21 and 22 move to the advance position on the nearest side of the chassis 1 and

halt at a playing position. Instead of stopping the rotation of the roller 4 upon completion of the above-mentioned transfer of the disc D, the rotation of the roller 4 may be stopped when the second detecting switch 33 turns on. In order to eject the disc D, from which reading information has been completed, to the outside of the main body of the disc player, when an ejection button (not shown) is operated, the motor 23 starts to rotate in the opposite direction so as to perform an operation in a sequence opposite to the above-mentioned operation, so that the first and second slide members 21 and 22 move backward from the advance position and return to the retreat position shown in Figs. 8A and 8B.

**[0064]** The car-mounted disc player according to a preferred embodiment is arranged such that the slide members 21 and 22 can be brought to a halt at the half-locked position during their assembly or between their final inspection and shipment. More particularly, when the slide members 21 and 22 move from the retreat position shown in Figs. 8A and 8B to the half-locked position shown in Figs. 9A and 9B, as shown in Fig. 12, the first drive portion 21f of the first slide member 21 abuts against the actuator portion 32a so as to activate the first detecting switch 32 to turn on; thus, by stopping the motor 23 in accordance with an operating signal of the first detecting switch 32, the slide members 21 and 22 can be reliably brought into a halt at the half-locked position. Then, as shown in Fig. 3, by inserting the temporal fixing pin 35 into the positioning hole 34 from the outside of the chassis 1 at the half-locked position, and then by latching the front of the temporal fixing pin 35 with the positioning hole or positioning depression (not shown) formed in the first slide member 21, the chassis 1 and the first slide member 21 can be connected to each other so as not to move mutually at the half-locked position as long as the temporal fixing pin 35 is not pulled out.

**[0065]** Accordingly, when the completely assembled car-mounted disc player is shipped and transported from its factory in a state of being loaded with a disc D such as a CD-ROM or DVD, for example, used for navigation, the drive unit 8 is maintained in the locked state while the disc D is being chucked at the half-locked position; therefore, even when a strong external vibration or shock is exerted on the disc player during transport, the loaded disc D is reliably prevented from

hitting against the chassis 1 or members and the like fixed to the chassis 1, and thus prevented from damage. Also, when a tilt of a laser beam emitted from the optical pickup 11 is adjusted at the final assembling stage of the disc player while the disc D is being driven to rotate, since the drive unit 8 is maintained in the locked state while the disc D is being chucked at the half-locked position, the disc D can be driven to rotate while the drive chassis 9 having the optical pickup 11 mounted thereon is kept in the locked state, whereby such an adjusting work can be easily done. When the temporal fixing pin 35 is pulled out by a purchaser of the disc player, the chassis 1 and the first slide member 21 are disconnected from each other. Thus, when the disc player is installed at a predetermined location in a car body for operation, the slide members 21 and 22 move back and forth without halting at the half-locked position, whereby the slide members 21 and 22 activate the clamp mechanism and the lock mechanism to perform the respective change-over operations. The disc player may have a CPU or the like having a program previously installed therein for moving the slide members 21 and 22 from the half-locked position to the playing position shown in Figs. 10A and 10B when the disc player is delivered and has an initial electric power applied thereon. Although the temporal fixing pin 35 serves as a connecting member for temporally fixing the chassis 1 and the first slide member 21 (and the second slide member 22) at the half-locked position, in place of the temporal fixing pin 35, an adhesive tape, clips, or the like may be used, or a combination of them may be used. Meanwhile, since the rack portion 21h of the first slide member 21 engages with the gear 38 at the half-locked position shown in Fig. 9A, the first slide member 21 is in connection with the motor 23. Accordingly, the temporal fixing pin 35 is not always necessary. However, when such a connecting member is disposed, the slide member 21 is reliably maintained in the half-lock state even when a stronger shock is exerted on the disc player.

[0066] Fig. 23 is a perspective view of a main part of a modification of the position-detecting means for detecting the half-locked position. As shown in the figure, when a first mark such as a projection 39 is formed on the upper surface of the first slide member 21 integrally therewith and also a second mark such as a



groove 40 is formed in the top chassis 2 fixed on the upper portion of the chassis 1 so that the projection 39 and the groove 40 mate with each other at the half-locked position, the half-locked position is visually detected with ease without the first detecting switch 32, whereby the first slide member 21 is reliably halted at this position. In this case, the motor 23 may be energized so as to move the first slide member 21 to the half-locked position; alternatively, the first and second slide members 21 and 22 can be manually moved to the half-locked position. The marks of the position-detecting means at the half-locked position are not limited to the projection 39 and the groove 40; instead, they may be printed marks, engraved marks, or the like.

[0067] Although the disc D is clamped between the clamper 15 and the turntable 13 by moving down the clamper 15 in the foregoing embodiment, on the contrary, the turntable may be moved up relative to the clamper so as to clamp the disc D therebetween. The lock mechanism and the change-over mechanism are not limited to those in the foregoing embodiment, and can be modified as needed.